

PTO 08-7947

CC=JP DATE=19991105 KIND=A
PN=11307791

SOLAR BATTERY MODULE
[TAIYO DENCHI MOJURU]

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UNITED STATES PATENT AND TRADEMARK OFFICE
Washington, D.C. October 2008

Translated by: FLS, Inc.

PUBLICATION COUNTRY	(19):	JP
DOCUMENT NUMBER	(11):	11-307791
DOCUMENT KIND	(12):	A
PUBLICATION DATE	(43):	19991105
APPLICATION NUMBER	(21):	10-112548
DATE OF FILING	(22):	19980422
ADDITION TO	(61):	
INTERNATIONAL CLASSIFICATION	(51):	H01L 31/04
PRIORITY	(30):	
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DESIGNATED CONTRACTING STATES	(81):	
TITLE	(54):	SOLAR BATTERY MODULE
FOREIGN TITLE	[54A]:	TAIYO DENCHI MOJURU

[Claim 1] A solar battery module, being a solar battery module having a plurality of bifacial solar battery cells arranged at an interval, which has a translucent light diffusing material on one side of the module where the light enters.

[Claim 2] A solar battery module, being a solar battery module having a plurality of bifacial solar battery cells arranged at an interval, which has a translucent material with a patterned indented surface on one side of the module where the light enters.

[Claim 3] A solar battery module, being a solar battery module having a plurality of bifacial solar battery cells arranged at an interval, which has translucent materials with patterned indented surfaces on both sides of the module where the light enters.

[Claim 4] The solar battery module according to Claim 2 or 3, wherein the interval between the indented patterns is less than one times the gap between the adjacent solar battery cells.

[Claim 5] The solar battery module according to Claim 2 or 3, wherein the haze rate at the above-mentioned translucent material is 20% or higher.

[Claim 6] The solar battery module according to Claim 2, wherein light reflective material is provided in part of the above-mentioned translucent material corresponding to the area between adjacent solar battery cells.

* Claim and paragraph numbers correspond to those in the foreign text.

[Claim 7] The solar battery module according to Claim 6, wherein the width of the above-mentioned light reflective material is 1 to 2 times the gap between adjacent the solar battery cells.

[Claim 8] The solar battery module according to one of Claims 2 - 5, wherein the above-mentioned translucent material at the area corresponding to the adjacent solar battery cells has convex patterns larger than at the other part.

[Claim 9] A solar battery module, being a solar battery module having a plurality of bifacial solar battery cells arranged at an interval, wherein the light reflective material corresponding to the above-mentioned solar cell area and the light diffusion material corresponding to the area between adjacent battery cells are provided on one side of the module where light enters.

[Claim 10] A solar battery module, being a solar battery module having a plurality of bifacial solar battery cells arranged at an interval, wherein a material is provided on the other light-entering side of the module by which the light coming from one light-entering side of the module and passing through the module is reflected into the module, and by which light coming from the other light-entering side of the module is diffused into the module.

[DETAILED DESCRIPTION OF THE INVENTION]

[0001] [Technical field of the invention]

This invention relates to a solar battery module having a plurality of bifacial solar battery cells.

[0002] [Prior art]

Solar battery modules with a plurality of solar battery cells come either in a mono-facial type which uses incident light coming only from the front side of the solar battery cells for power generation while covering the back side with light-blocking film, or in bi-facial type which uses incident light coming from the front as well as from the back side of the solar battery cells for power generation wherein the back side is covered by a transparent film. When both types of solar battery modules are set under the same condition and their electromotive force levels are checked, a bifacial solar battery module results in about 5~10% improvement in output compared to a mono-facial solar battery module.

[0003] Figure 12 is a cross-section view of such a conventional solar battery module. In this figure, '1' are bi-facial solar battery cells where an amorphous semi-conductor layer is formed on a substrate made from a crystalline semi-conductor, for example, where semi-conductor binding is formed between the crystalline substrate and the amorphous semiconductor, where translucent conductive film and a collector electrode are formed on the front and back sides, and where electromotive force is generated from incident light from both the front and back sides.

[0004] This type of multiple solar battery cells 1 arranged with a prescribed interval between adjacent cells are buried in an EVA (Ethylene vinyl acetate) layer 2. Further, on the front side of the EVA layer is a glass plate 3 made from enforced glass, while on the back side of the EVA 2 is a back-side film 40 whose entire surface is either transparent

or not transparent. In this case, when incident light from the back side is to be used for power generation, a back-side film 40 is made from a film whose entire surface is flat and transparent; while when incident light from the back side is not to be used for power generation, a back-side film 40 is made from a film whose entire surface is flat and non-transparent.

[0005] [Problems to be resolved by the invention]

Arrow signs in Figure 12 show the routes of incident light in a conventional solar battery module using a back-side film 40 whose entire surface is transparent. Incident light, coming from the front side or back side into the area where solar battery cells 1 exist, enters into such solar battery cells 1 and contributes to electromotive generation. However, incident light entering the area where solar battery cells 1 do not exist, namely incident light entering the area between adjacent solar battery cells 1 and 1, would not enter any solar battery cells 1 and would simply pass through the transparent back-side film 40. Thus, conventional solar battery modules could not utilize incident light entering the area between adjacent solar battery cells, resulting in poor power generation efficiency and low output voltage.

[0006] The objective of this invention, in view of such a state of the matter, is to provide a solar battery module that can efficiently utilize lights entering between adjacent solar battery cells to improve power generation efficiency.

[0007] [Means of solving the problems]

The solar battery module according to Claim 1, being a solar battery module having a plurality of bifacial solar battery cells arranged at an interval, has a translucent light diffusing material on one side of the module where the light enters.

[0008] The solar battery module according to Claim 2, being a solar battery module having a plurality of bifacial solar battery cells arranged at an interval, has a translucent material with a patterned indented surface on one side of the module where the light enters.

[0009] The solar battery module according to Claim 3, being a solar battery module having a plurality of bifacial solar battery cells arranged at an interval, has a translucent material with patterned indented surfaces on both sides of the module where the light enters.

[0010] The solar battery module according to Claim 4 is a solar battery module according to Claim 2 or 3 wherein the interval between the indented patterns in the above-mentioned transparent material is less than one times the gap between the adjacent solar battery cells.

[0011] The solar battery module according to Claim 5 is a solar battery module according to Claim 2 or 3 wherein the haze rate at the above-mentioned transparent material is 20% or higher.

[0012] The solar battery module according to Claim 6 is a solar battery module according to Claim 2 wherein the light reflective material is provided in part of the above-mentioned translucent material corresponding to the area between adjacent solar battery cells.

[0013] The solar battery module according to Claim 7 is a solar battery module according to claim 6 wherein the width of the above-mentioned light reflective material is 1 to 2 times the gap between adjacent solar battery cells.

[0014] The solar battery module according to Claim 8 is a solar battery module according to one of Claims 2 - 5, wherein the above-mentioned translucent material at the area corresponding to adjacent solar battery cells has convex patterns larger than at the other part.

[0015] The solar battery module according to Claim 9 is a solar battery module, being a solar battery module having a plurality of bifacial solar battery cells arranged at an interval, wherein the light reflective material corresponding to the above-mentioned solar cell area and the light diffusion material corresponding to the area between adjacent battery cells are provided on one side of the module where light enters.

[0016] The solar battery module according to Claim 10 is a solar battery module, being a solar battery module having a plurality of bifacial solar battery cells arranged at an interval, wherein a material is provided on the other light-entering side of the module by which the light coming from one light-entering side of the module and passing through the module is reflected into the module, and by which light coming from the other light-entering side of the module is diffused into the module.

[0017] Under the solar battery module of this invention, a light-diffusing translucent material, for example a translucent material with a patterned indented surface, is provided at the back side of the

module where the light enters. Incident light coming from the front side of the module and passing between adjacent solar battery cells is diffused by this translucent material on the back side, and part of such diffused light enters the solar battery cells. Therefore, incident light which was not utilized under a conventional setup can be utilized efficiently and the photoelectric conversion rate is improved.

[0018] Further, by providing a light-diffusing translucent material on the front side of the module also, incident light from the back side of the module passing between adjacent solar battery cells is also diffused by the translucent material on the front side, part of such diffused light enters solar battery cells, further improving the photoelectric conversion efficiency.

[0019] With this type of solar battery module having a translucent material with a patterned indented surface on the back side of the module, the scattering effect can be increased by such methods as making the indentation interval of the translucent material less than one times the interval between adjacent solar battery cells, making the haze rate of the translucent material equal to or greater than 20%, or providing larger convex patterns to the translucent material in the area corresponding to the gaps between adjacent solar battery cells, compared to the case where such methods are not applied.

[0020] Further, with a solar battery module having a translucent material with a patterned indented surface on the back side of the module, incident light from the front side of the module passing between adjacent

solar battery cells can be directed more efficiently into solar battery cells by providing light-reflective material at parts of the translucent material corresponding to gaps between adjacent solar battery cells. However, if the width of such light-reflective material is too large, incident light coming to solar battery cells from the back side of the module would be blocked. Therefore, such width should ideally be 1~2 times the gap between adjacent solar battery cells.

[0021] Another solar battery module under this invention provides, on the back side of the solar battery module, a light-reflective material corresponding to the area where the solar battery cells exist, and a light-diffusing material corresponding to the gap between adjacent solar battery cells. Incident light coming from the front side of the module that passes between adjacent solar battery cells would be diffused by light-diffusing material on the back side, be reflected by light-reflective material, and enter the solar battery cells from the back side. Therefore, incident light which was not utilized under the conventional setup can be utilized efficiently and the photoelectric conversion rate is improved.

[0022] Another solar battery module under this invention provides, on the back side of the module, material which reflects light coming from the front side of the module and passing through the module and which, at the same time, diffuses light coming from the back side of the module. Incident light coming from the front side of the module that passes between adjacent solar battery cells would be reflected by this material on the back side and enter the solar battery cells from the back side. And incident

light which would have gone straight to the area between adjacent solar battery cells is diffused by this material and enters solar battery cells from the back side. Therefore, incident light which was not utilized under the conventional setup can be utilized efficiently and the photoelectric conversion rate is improved.

[0023] [Configuration of embodiments of the invention]

Details of this invention are explained next using illustrations showing the configuration of embodiments. In the following explanations, one side of the module within the parent claim where light enters indicates the back side of the solar battery module.

(Configuration of the 1st embodiment)

Figure 1 is a cross-section view of the solar battery module under the 1st embodiment of this invention. In this figure 1, '1' is a bifacial type solar battery cell. A plurality of bifacial solar battery cells 1 (thickness: 0.1~0.7 mm) which are arranged at a prescribed interval (1 mm or more) between adjacent cells are buried in the EVA layer 2 (thickness: 0.2~3 mm, refractive index: 1.5). Further, on the front side of the EVA layer 2 is a glass plate 3 (refractive index: 1.5) made from white enforced glass, for example, while on the back side of the EVA layer 2 is a translucent sheet 4 (thickness: 0.05~0.2mm, refractive index: 1.5) with a patterned indented surface made from PET (Poly Ethylene Terephthalate) or PVF (Poly Vinyl Fluoride).

[0024] Figure 2 shows a configuration diagram showing one example of a bifacial solar battery cell 1. In Figure 2, '11' is an n-type crystalline silicon substrate made from crystalline semiconductors such as mono-crystal silicon and poly-crystal silicon. On one main surface (the front surface) of the crystalline silicon substrate 11 are i-type amorphous silicon layer 12, and p-type amorphous silicon layer 13 laminated in that order. Formed on top of that are a translucent conductive film 14 made from ITO and a comb-shape collector electrode 15 made from Ag. On the other main surface (the back surface) of the crystalline silicon substrate 11 are i-type amorphous silicon layer 16, and n-type amorphous silicon layer 17 laminated in that order. Formed on top of that are a translucent conductive film 18 made from ITO and a comb-shape collector electrode 19 made from Ag.

[0025] A solar battery module of such configuration has a glass plate 3, an EVA sheet for an EVA layer 2, a plurality of solar battery cells 1, an EVA sheet for an EVA layer 2, and a translucent sheet 4 with a patterned indented surface, laminated in that order. These laminated layers are bonded with heat and pressure into an integrated unit to produce a final product. An efficient way to produce a translucent sheet 4 with a patterned indented surface would be to press a flat EVA sheet with a patterned indented press roller.

[0026] The way the incident light moves in this 1st embodiment is explained next by referencing Figure 1. Incident light (arrow L_A) entering from the front side of the module through the glass plate 3 into the area

where solar battery cells 1 exist would enter the solar battery cells 1 directly from the front side. Further, incident light (arrow L_B) entering from the back side of the module through the translucent sheet 4 into the area where solar battery cells 1 exist would be diffused partly and enter the solar battery cells 1 from its back side.

[0027] On the other hand, incident light (arrow L_C) coming from the front side of the module through a glass plate 3 into the gap area between adjacent solar battery cells 1 and 1, namely into the area where solar battery cells 1 do not exist, is partly diffused by the translucent sheet 4. And part of the diffused light enters the solar battery cells 1 from its back side. Further, part of the diffused light is reflected by the border area between the EVA layer 2 and the glass plate 3 and enters the solar battery cells 1 from the front side.

[0028] In this manner, the photoelectric conversion efficiency is improved, since not only the incident light coming from front and back sides of the solar battery module and reaching where the solar battery cells 1 exist, but also the incident light reaching the area between adjacent solar battery cells 1 and 1 can contribute to the electromotive force. With this configuration of the 1st embodiment, output can be improved by around 2% compared to a conventional example which uses a flat and translucent back-side film 40 shown in Figure 12.

[0029] The relationship between the gap between adjacent solar battery cells 1 and 1 and the interval between the patterned indentation formed on the translucent sheet 4 is as follows. If the interval between

the patterned indentation is larger than the gap between the solar battery cells 1 and 1, as shown in Figure 3, the width of the concave section of the translucent sheet 4 would be larger than the gap between solar battery cells 1 and 1, and this concave section would cover the entire area between the solar battery cells 1 and 1. In this case, the incident light (arrow L_D) coming from the front side through the glass plate 3 into the area between adjacent solar battery cells 1 and 1 would be diffused in large part and passes again through the gap between the solar battery cells 1 and 1 without entering the solar battery cells 1. Therefore, the diffused light entering the solar battery cells 1 from the back side would be reduced. Thus, it is ideal that at least one convex section exists in the area between the solar battery cells 1 and 1. Thus, a translucent sheet 4 with a patterned indented surface that the solar battery module uses would be processed so that the interval between such patterns is less than one times the gap between adjacent solar battery cells 1 and 1. If such a translucent sheet 4 is used, there would always be at least one convex section between adjacent solar battery cells 1 and 1, the incident light reaching this area from the front side can be utilized effectively.

[0030] Thus, in order to diffuse and reflect light, the patterned indentation on the translucent sheet 4 should have a fine pattern of concave and convex shapes. However, if the pitch of such shapes is too narrow, it would create a semi-translucent (cloudy) sheet. Thus, for an esthetic reason, a patterned indentation is sometimes created with a larger pitch.

Even in such cases, however, the output can be increased if a convex section exists in the area between adjacent solar battery cells 1 and 1.

[0031] The relationship between the haze rate of the translucent sheet 4 and the output characteristics is as follows: The haze rate (%) showing a light scattering effect is defined by the equation (1) below, and the total transmission rate (%) is defined by the average transmission rate in the visible range (400~700 nm).

Haze rate = {(scattered transmission rate of light) / (total transmission rate of light)} x 100 (1)

Here,

Scattered transmission rate of light : (Total transmission rate) -
(Straight line transmission rate)

Total transmission rate of light: Transmission rate against all
transmission light measured by an integrating sphere

[0032] Figure 4 is a graph showing the relationship between the haze rate (horizontal axis) of the translucent sheet 4 and the short-circuit current I_{SC} (vertical axis). Although the short-circuit current I_{SC} increases as the haze rate increases until the haze rate reaches 20%, the short-circuit current I_{SC} changes little once the haze rate exceeds 20%. Thus, the output characteristics can be improved if we use translucent sheet 4 whose haze rate exceeds 20%.

[0033] (Configuration of the 2nd embodiment)

Figure 5 is a cross-section view of the solar battery module under the 2nd embodiment of this invention. In Figure 5, parts that are the same

as in Figure 1 are assigned the same numbers, and their explanations are omitted. In the 2nd embodiment, a patterned indentation treatment is applied to the front side as well as the back side. Namely, in the 2nd embodiment, the surface of the glass plate 3 is not flat, but is treated with a patterned indentation. Otherwise, the configuration is the same as in the above-mentioned 1st embodiment. This 2nd embodiment can be produced by treating under heat and pressure in a similar manner as in the 1st embodiment.

[0034] The way the incident light moves in this 2nd embodiment is explained next by referencing Figure 5. Incident light (arrow L_E) entering from the front side of the module through the glass plate 3 into the area where solar battery cells 1 exist would be partly diffused and enter the solar battery cells 1 from the front side. Further, incident light (arrow L_F) entering from the back side of the module through the translucent sheet 4 into the area where solar battery cells 1 exist would be diffused partly and enter the solar battery cells 1 from its back side.

[0035] On the other hand, incident light (arrow L_G) coming from the front side of the module through a glass plate 3 into the gap area between adjacent solar battery cells 1 and 1, namely into the area where solar battery cells 1 do not exist, is partly diffused by the translucent sheet 3. And part of the diffused light enters the solar battery cells 1 from its front side. And part of the light moving in a straight line is diffused by the translucent sheet 4. And part of this diffused light enters the solar battery cells 1 from its back side.

[0036] In this manner, the photoelectric conversion efficiency can be improved, since not only the incident light from the front and back sides of the module reaching the area where the solar battery cells 1 exist, but also the incident light coming to the area between adjacent solar battery cells 1 and 1, can contribute to the generation of the electromotive force. Additionally, the diffusion and reflection of light happens more frequently than in the 1st embodiment, increasing the light confinement effect. With this configuration of the 2nd embodiment, output can be improved by around 3% compared to a conventional example which uses a flat and translucent back-side film 40 shown in Figure 12.

[0037] (Configuration of the 3rd embodiment)

Figure 6 is a cross-section view of the solar battery module under the 3rd embodiment of this invention. In Figure 6, parts that are the same as in Figure 1 are assigned the same numbers and their explanations are omitted. Under this 3rd embodiment, a high-reflection film 5 (thickness: 100~5000Å), made from Ag for example, is provided on the translucent sheet 4 with a patterned indented surface at areas corresponding to the gaps between adjacent solar battery cells 1 and 1. This high-reflection film 5 completely covers the areas between solar battery cells 1 and 1, and is set to be slightly larger than the gap areas. Otherwise, the configuration is the same as in the above-mentioned 1st embodiment.

[0038] As material for high-reflection film 5, high-reflection metal such as Au and Al could be used in addition to Ag. Further, the

high-reflection film 5 could also use material from a polymer material such as PVF and PET treated for white color.

[0039] The way the incident light moves in this 3rd embodiment is explained next by referencing Figure 6. Incident light (arrow L_H) entering from the front side of the module through the glass plate 3 into the area where solar battery cells 1 exist would enter the solar battery cells 1 directly from the front side. Further, incident light (arrow L_I) entering from the back side of the module through the translucent sheet 4 into the area where high-reflection film 5 does not exist would be diffused partly and enter the solar battery cells 1 from its back side.

[0040] On the other hand, incident light (arrow L_J) coming from the front side of the module through a glass plate 3 into the gap area between adjacent solar battery cells 1 and 1, namely into the area where solar battery cells 1 do not exist, is reflected by high-reflection film 5. And part of the reflected light enters the solar battery cells 1 from its back side.

[0041] In this manner, the photoelectric conversion efficiency is improved since not only the incident light coming from the front and back sides of the solar battery module and reaching where the solar battery cells 1 exist, but also the incident light reaching the area between adjacent solar battery cells 1 and 1 can contribute to the electromotive force.

[0042] The necessary width and output characteristics of the high-reflection film 5 are as follows: Although a high-reflection film

with a similar width as the gap between the solar battery cells 1 and 1 would be sufficient to take care of the incident light coming at roughly the vertical angle against the surface of the module, a larger width than the gap between the solar battery cells 1 and 1 is necessary to take care of the incident light (arrow L_K), as shown in Figure 6, coming at an angle against the surface of the module. However, if the set width of the high-reflection film 5 is too large, it could block the incident light coming from the back side of the module, reducing the output characteristics instead.

[0043] Figure 7 is a graph showing the relationship between the width of the high-reflection film 5 corresponding to the gaps between solar battery cells 1 and 1 (horizontal axis), and the short-circuit current I_{SC} (vertical axis). As you can see, the short-circuit current I_{SC} increases with the width until the width of the high-reflective film 5 reaches 2 times the gap between the solar battery cells 1 and 1. However, the short-circuit current I_{SC} begins to decrease gradually as the width exceeds 2 times the gap between cells. Thus, the output characteristics can be improved by setting the width of the high-reflection film 5 to the range of 1~2 times the gap between solar battery cells 1 and 1.

[0044] (Configuration of the 4th embodiment)

Figure 8 is a cross-section view of the solar battery module under the 4th embodiment of this invention. In Figure 8, the parts that are the same as in Figure 1 are assigned the same numbers and their explanations are omitted. Under this 4th embodiment, the patterned indentation on the

surface of the translucent sheet 4 is not even. Specifically, the section corresponding to the area between the solar battery cells 1 and 1 has a larger convex section 4a compared to the area where the solar battery cells 1 exist. Otherwise, the configuration is the same as in the above-mentioned 1st embodiment.

[0045] The shape of the convex section 4a at the area corresponding to the gap area between the solar battery cells 1 and 1 could be pointed at its tip, as shown in Figure 8, or could be round at its tip as shown in Figures 9 (a) and (b).

[0046] A solar battery module of this structure is produced by stacking layers of a glass plate 3, an EVA sheet for an EVA layer 2, a plurality of solar battery cells 1, an EVA sheet for EVA layer 2, and a translucent sheet 4 with a patterned indented surface, and integrating them into one unit by bonding the layers under heat and pressure. During this heat-and-pressure bonding process, large convex sections 4a can be selectively formed which correspond to the gap area between the solar battery cells 1 and 1 by pressing against the translucent sheet 4 an embossing form with a plurality of protrusions at the same pitch as the gap between the solar battery cells 1 and 1.

[0047] Under the 4th embodiment, since such large convex sections 4a were selectively formed in the area that requires a diffusion effect, it is possible to diffuse a larger part of incident light (arrow L_M) coming from the front side of the module and entering the area between adjacent solar battery cells 1 and 1, namely the area where any solar battery cells

1 do not exist, and at the same time, such incident light is more likely to be totally reflected on the back side.

[0048] (Configuration of the 5th embodiment)

Figure 10 is a cross-section view of the solar battery module under the 5th embodiment of this invention. In Figure 10, parts that are the same as in Figure 1 are assigned the same numbers and their explanations are omitted. Under the 5th embodiment, the back side of the solar battery module has a light-diffusing material 6, made from such materials as glass, polycarbonate, or acrylic, in the area between adjacent solar battery cells 1 and 1, while it has a reflective plate 7, made from a heat-reflecting glass, for example, in the area where solar battery cells 1 exist. Otherwise, the configuration is the same as in the above-mentioned 1st embodiment.

[0049] The way the incident light moves in this 5th embodiment is explained next by referencing Figure 10. Incident light (arrow L_N) entering from the front side of the module through the glass plate 3 into the area where solar battery cells 1 exist would enter the solar battery cells 1 directly from the front side. Incident light (arrow L_O) entering from the back side of the module through the reflective plate 7 into the area where solar battery cells 1 exist would enter the solar battery cells 1 directly from the back side.

[0050] On the other hand, incident light (arrow L_P) coming from the front side of the module into the area between adjacent solar battery cells 1 and 1, namely into the area where solar battery cells 1 do not exist, would be diffused by the light-diffusing material 6, and part of the

diffused light is reflected by the reflective plate 7 and enters solar battery cells 1 from the back side.

[0051] In this manner, the photoelectric conversion efficiency is improved, since not only the incident light coming from the front and back sides of the solar battery module and reaching where the solar battery cells 1 exist, but also the incident light reaching the area between adjacent solar battery cells 1 and 1 can contribute to the electromotive force.

[0052] (Configuration of the 6th embodiment)

Figure 11 is a cross-section view of the solar battery module under the 6th embodiment of this invention. In Figure 11, parts that are the same as in Figure 1 are assigned the same numbers and their explanations are omitted. Under the 6th embodiment, the back side of the solar battery module has a back-surface material 8 made from a transparent and highly refractive material such as poly carbonate (refractive index: about 1.5). This back-surface material 8 has a patterned indentation, and the formation pitch of such indentation is half of the placement pitch of the solar battery cells 1, and the location of its concave section 8a matches the area between adjacent solar battery cells 1,1 and the center section of each solar battery cell. Otherwise, the configuration is the same as in the above-mentioned 1st embodiment.

[0053] The way the incident light moves in this 6th embodiment is explained next by referencing Figure 11. Incident light (arrow L₀) entering from the front side of the module through the glass plate 3 into the area

where solar battery cells 1 exist would enter the solar battery cells 1 directly from the front side. Further, incident light (arrow L_R) entering from the back side of the module through the back-surface sheet 8 into the area where solar battery cells 1 exist would be diffused partly and enter the solar battery cells 1 from its back side.

[0054] On the other hand, incident light (arrow L_S) coming from the front side of the module into the gap area between adjacent solar battery cells 1 and 1, namely into the area where solar battery cells 1 do not exist, is multiply reflected by the back-surface material 8 and the reflected light enters the solar battery cells 1 from the back side. On the other hand, incident light (arrow L_T) coming from the back side of the module into the gap area between adjacent solar battery cells 1 and 1, namely into the area where solar battery cells 1 do not exist, is diffused by the back-surface material 8 and part of the diffused light enters the solar battery cells 1 from the back side.

[0055] In this manner, the photoelectric conversion efficiency is improved, since not only the incident light coming from the front and back sides of the solar battery module and reaching where the solar battery cells 1 exist, but also the incident light reaching the area between adjacent solar battery cells 1 and 1 can contribute to the electromotive force.

[0056] [Advantageous effect of the invention]

With the solar battery module of this invention, since a translucent material that diffuses light is provided at the back side of the module,

incident light entering in the area between adjacent solar battery cells, which could not be utilized before, can be utilized effectively, thereby improving the photoelectric conversion efficiency.

[BRIEF DESCRIPTION OF THE DRAWING]

[Figure 1] A cross-section view of the solar battery module (1st embodiment) of this invention.

[Figure 2] A configuration diagram of bi-facial solar battery cells.

[Figure 3] This shows an example of a bad pattern of indentations on a translucent sheet.

[Figure 4] A graph showing the relationship between the haze rate of the translucent sheet of the solar battery module (1st embodiment) of this invention and the short-circuit current.

[Figure 5] A cross-section view of the solar battery module (2nd embodiment) of this invention.

[Figure 6] A cross-section view of the solar battery module (3rd embodiment) of this invention.

[Figure 7] A graph showing the relationship between the placement width of the high-reflective film of the solar battery module (3rd embodiment) of this invention and the short-circuit current.

[Figure 8] A cross-section view of the solar battery module (4th embodiment) of this invention.

[Figure 9] A graph showing another pattern example of a convex section of the translucent sheet solar battery module (4th embodiment) of this invention.

[Figure 10] A cross-section view of the solar battery module (5th embodiment) of this invention.

[Figure 11] A cross-section view of the solar battery module (6th embodiment) of this invention.

[Figure 12] A cross-section view of a conventional solar battery module.

[Explanation of codes]

1 ... Solar battery cell

2 ... EVA layer

3 ... Glass plate

4 ... Translucent sheet

4a ... Convex section

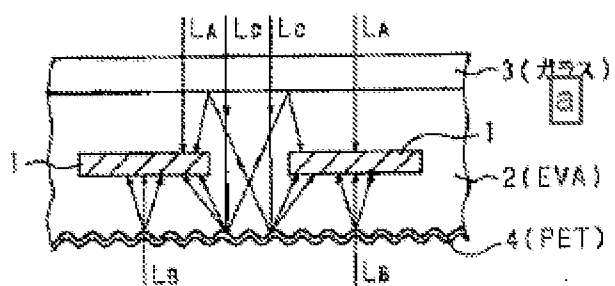
5 ... High-reflective film

6 ... Light-diffusing material

7 ... Reflection board

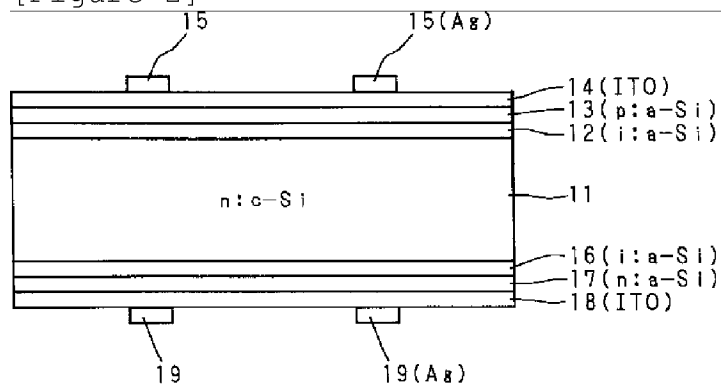
8 ... Back-surface material

[Figure 1]

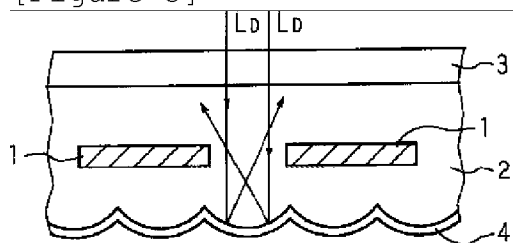


Key:
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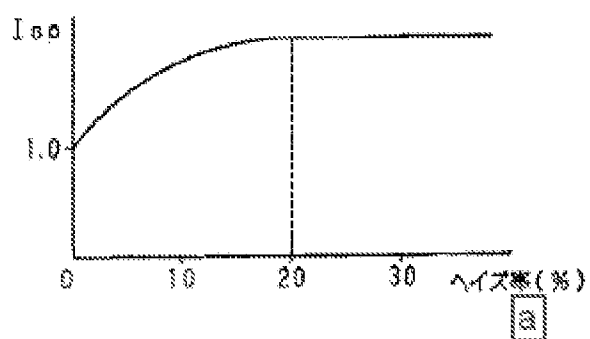
[Figure 2]



[Figure 3]



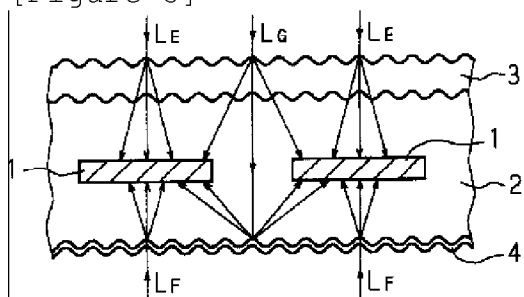
[Figure 4]



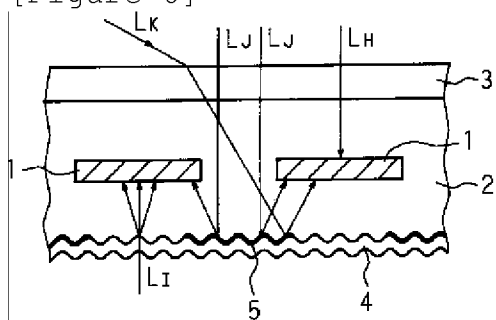
Key:

a) Haze rate (%)

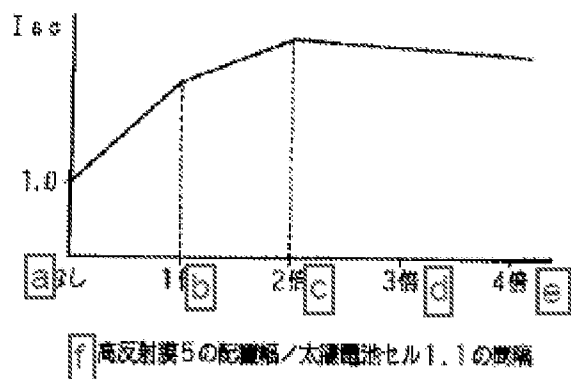
[Figure 5]



[Figure 6]



[Figure 7]



Key:

a) Zero

b) 1 time

c) 2 times

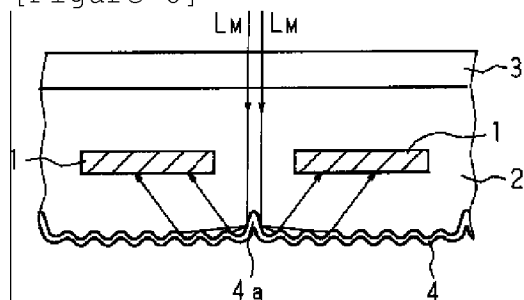
d) 3 times

e) 4 times

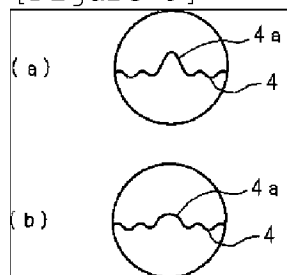
f) Placement width of high-reflective film 5

/ Interval between solar battery cells 1,1

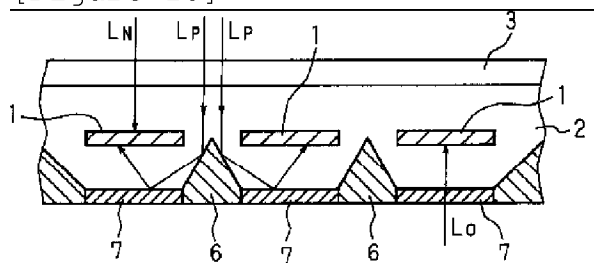
[Figure 8]



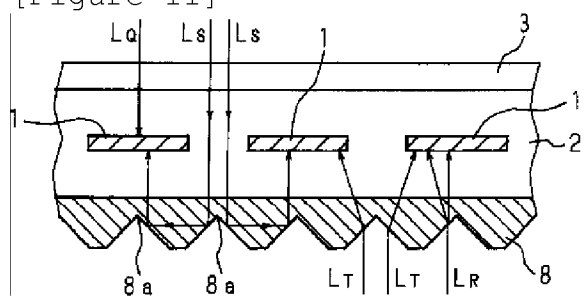
[Figure 9]



[Figure 10]



[Figure 11]



[Figure 12]

